PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : F02M 27/04, C02F 1/48

A1

(11) International Publication Number: WO 96/10692

(43) International Publication Date: 11 April 1996 (11.04.96)

(21) International Application Number: PCT/GB95/02344

(22) International Filing Date: 3 October 1995 (03.10.95)

(30) Priority Data:
9419932.0 4 October 1994 (04.10.94) GB

(71) Applicant *(for all designated States except US)*: MAGNO-FLO LIMITED [GB/GB]; Tigh-Na-Greine, Kinlochard, Stirlingshire FK8 3TL (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: BROWN, John [GB/GB]; Tigh-Na-Greine, Kinlochard, Stirlingshire FK8 3TL (GB).

(74) Agent: MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).

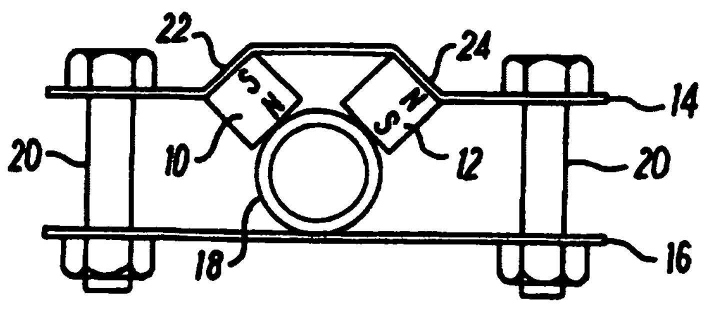
(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: MAGNETIC TREATMENT OF FLUIDS

(57) Abstract

A device for the magnetic treatment of fluids comprises a plurality of neodymium-based permanent magnets (10, 12) mounted around a fluid conduit (18) by means of suitable brackets or housing (14, 16). In the treatment of gas and liquid fuels, for improved combustion efficiency, and in the treatment of water, the magnets are oriented with dissimilar poles adjacent the conduit. In bench tests, the use of the devices was shown to produce consistent improvements in diesel engine performance and fuel consumption across a range of engine speeds and loads.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgystan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

Magnetic Treatment of Fluids

The present invention relates to apparatus for magnetically treating fluids. In the case of liquid or gas fuels, the apparatus enhances the combustion efficiency, by application of the invention to fuel supply lines. In the case of water, the invention serves to reduce the deposition of solids from the water.

There have been numerous proposals for devices making use of permanent magnets (and electric fields) in fluid treatment for the various purposes stated above. However, these have all been relatively complex in structure, involving elaborate casings and brackets, encapsulated magnets, and magnets machined to specific shapes. These factors all have the effect of increasing the cost of the devices. The relatively low strength of the magnetic materials used in such devices has also limited their effectiveness in use. In addition, none of the prior devices known to the present Applicants have been effective in enhancing the performance of diesel fuel engines. Examples of prior devices are disclosed in GB-A-1189888, US-A-2652925, US-A-3228878,

US-A-2939830, US-A-3349354, US-A-4146479, US-A-4153559, US-A-4210535, US-A-4367143, US-A-4372852 and US-A-4605498.

It is an object of the present invention to provide improved devices for magnetic treatment of fluids. The primary object of the invention is to provide devices exhibiting improved effectiveness in fluid treatment. A second object of the invention is the provision of devices which are simple in construction and flexible in use. A further object of the invention is the provision of magnetic fluid treatment devices which are effective in improving the performance of diesel engines.

In accordance with the invention there is provided a magnetic fluid treatment device comprising a plurality of permanent magnets and bracket means adapted, in use, to hold said magnets in a predetermined orientation about a fluid conduit, wherein said magnets are formed from neodymium-based magnetic material.

Preferably, said magnets are oriented with their polar axes extending substantially radially from the central axis of said conduit.

Preferably also, in the treatment of gas and liquid fuels for improved combustion efficiency, and in the treatment of water, said magnets are oriented with differing poles adjacent said conduit. Most preferably, there is at least one magnet located at a first location with its north pole adjacent the conduit and at least a second magnet located at a second location with its south pole adjacent the conduit.

Preferably also, said bracket means comprise at least an upper and a lower bracket, adapted to be secured together around a conduit, at least one of said brackets providing a seating surface for at least one of said magnets.

In accordance with a second aspect of the invention there is provided a magnetic fluid treatment method comprising mounting a plurality of neodymium-based permanent magnets in a predetermined orientation about a fluid conduit.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a schematic sectional view showing a first embodiment of the invention installed on a first tubular conduit;

Fig. 2 is a schematic sectional view showing a second embodiment of the invention installed on a second tubular conduit;

Fig. 3 is a plot of average fuel consumption rate against load, for a range of engine speeds, in bench tests of a diesel engine with and without devices in accordance with the invention; and

Figs. 4(a) and (b) respectively are plots of brake thermal efficiency versus brake power and brake specific fuel consumption versus brake power, at an engine speed of 2000rpm, in bench tests of a diesel engine with and

without devices in accordance with the invention.

Referring now to the drawings, Fig. 1 shows a magnetic fluid treatment device comprising first and second permanent magnets 10, 12, an upper mounting bracket 14 and a lower baseplate 16 installed on a tubular conduit 18, typically a 6 mm diameter fuel line. The device is secured to the conduit by means of bolts 20 or the like fastening the upper bracket 14 and the lower baseplate 16 to one another.

The upper bracket 14 has an angled sectional profile providing first and second angled magnet seating surfaces 22, 24 which retain the magnets 10, 12 in the desired orientation. In this example the magnets are disposed with their polar axes extending substantially radially through the conduit, the angle of intersection of said polar axes being approximately 90 degrees. The brackets are suitably of coated metal strip material, approximately 3 mm in thickness.

In the case of gas and liquid fuels (including petrol, diesel-oil and kerosene) the magnets 10, 12 are oriented with opposite poles adjacent the conduit. This is also the case for the treatment of water.

Fig. 2 shows a second embodiment of the invention comprising first and second magnets 26, 28, and upper and lower mounting brackets 30, 32, installed on a relatively larger tubular conduit 34, typically a 22 mm diameter pipe as used for water and in gas or oil fired boilers.

In this case, the brackets are each angled and each

provide a seating surface 36, 38 for one of the two magnets 26, 28, which are located on opposite sides of the conduit 34. The brackets are again secured in position by means of bolts 40, 42 or the like. The polar orientation of the magnets with respect to the conduit is the same as for the previous embodiment: opposite poles adjacent the conduit for the treatment of fuels and water; south poles adjacent the conduit for the treatment of water.

Where the devices of Figs. 1 and 2 are applied to fuel lines, the efficiency of fuel combustion is enhanced, and when applied to water pipes the deposit of solids is reduced and the build up of deposits such as lime scale is reduced accordingly. In accordance with the present invention, the magnets employed in the devices are high strength neodymium type magnets, suitably Neorem magnets from Swift Levick Magnets Limited. These magnets are many times more powerful than the types employed in prior devices of this type, and the effectiveness of the devices in treating fluids is correspondingly enhanced.

The construction of the devices, using simple angled brackets to locate the magnets on the desired conduit in the required orientation, is substantially less complex than in prior devices, and magnets of simple, standard geometrical configurations may be used. The brackets might comprise simple moulded housings of plastics or other suitable materials, configured to suit the shape and desired orientation of the magnets.

Whereas previous magnetic fluid treatment devices have been found to be ineffective in enhancing the performance of diesel engines, devices in accordance

with the present invention have been found to produce consistent improvements in diesel engine performance when mounted on fuel lines adjacent the fuel injectors.

The effects of the use of the devices on the performance and fuel consumption of diesel engines was tested in bench tests using a Perkins T4.236 diesel engine with turbocharged injection. The magnets used were type N410A, formed from iron, neodymium and boron using the powder metallurgical process and shaped by uniaxial pressing. The typical tolerances of such sintered, uniaxially pressed magnets are +/-1%. The typical physical and mechanical properties of the magnets were as follows:

Curie Temperature (°C)	-	310
Hardness (HVS)	-	500 - 600
Tensile Strength (N/mm^2)	-	80 - 100
Density (g/cm^3)	-	7.5
Electrical Resistivity (μΩcm)	-	140 approx.
Specific Heat (J/kgK)	-	500
Magnetising Field (kA/m)	-	2500

The nominal values of remanence, coercivity and energy product were 1.15T, 870 kA/m and 250 kJ/m^3, respectively. Each magnet was of cylindrical shape of approximately 27mm diameter and 15mm height and was housed in a plastic case having flanges and channels for clamping about a pipe.

The Perkins diesel engine T4.236 engine with turbocharged injection used in the tests had a maximum speed governed at 2800rpm with 23% torque back-up over 1400rpm. The bore diameter and stroke of the engine were 98.4mm and 127mm respectively. The engine had

four in-line cylinders and a capacity of 3.86 litres, running on four stroke with a firing order 1-3-4-2 and a compression ratio of 16:1. The engine drove a dynamometer (Dyno Mark 1, manufactured by Heenan and Froude Limited).

The set-up was controlled by a computer and fully instrumented to measure various temperatures, pressures, fuel consumption rate, brake load and speed.

The procedure of the experiment was as follows:

1. Without the magnets, the engine was started and allowed to run until thoroughly warm.
2. The engine was set to run at 1200rpm and drag load.
3. A fuel logging program was run to record fuel consumption for the period 10 to 30 seconds.
4. The time elapsed and fuel consumption were noted and the fuel consumption rate calculated therefrom.
5. Steps 3 and 4 were repeated for different loads from 20Nm to 100Nm in 10Nm increments.
6. Steps 2 to 5 were repeated for different speeds up to 2800rpm in 200rpm increments.

The experiment was repeated once, again without the magnets, two days later.

The experiment was then repeated twice with the magnets having been mounted on the four fuel injection pipes while the engine was cold. Again, there were two days between tests.

The test results showed substantial consistency between the first and second trials both with and without the magnets.

Fig. 3, shows a plot of average fuel consumption rate against the load for different engine speeds, where the dotted lines indicate results without the magnets and the solid lines indicate results with the magnets fitted. It can be seen that the fuel consumption rate increases as load increases for each particular speed, and as the speed increases for a particular load. It can clearly be seen that the fuel consumption rate is consistently lower with the use of the magnets than without the magnets.

Fig. 4 shows plots of: (a) brake thermal efficiency versus brake power; and (b) brake specific fuel consumption versus brake power for an engine speed of 2000rpm, where the dotted lines again indicate results without the magnets and the solid lines indicate results with the magnets fitted. These plots show that both the brake thermal efficiency and the brake specific fuel consumption were consistently improved by the use of the magnets across a range of loads. Similar improvements were recorded across the full range of engine speeds from 1200rpm to 2800rpm. The improvements were generally more apparent at higher speeds and loads, but there were consistent improvements across all speeds and loads.

The test results indicate that devices in accordance with the invention provide consistent, significant improvements in engine efficiency and fuel consumption when employed on the fuel lines of diesel engines.

The invention thus provides improvements in magnetic fluid treatment devices, with respect both to the effectiveness and the construction of such devices, and provides a means whereby the operation of diesel engines may be significantly improved by magnetic treatment.

Modifications and improvements may be incorporated without departing from the scope of the invention.

Claims

1. A magnetic fluid treatment device comprising a plurality of permanent magnets and bracket means adapted, in use, to hold said magnets in a predetermined orientation about a fluid conduit, wherein said magnets are formed from neodymium-based magnetic material.

2. A device as claimed in Claim 1, wherein said magnets are oriented with their polar axes extending substantially radially from the central axis of said conduit.

3. A device as claimed in Claim 1 or Claim 2, wherein in the treatment of gas and liquid fuels for improved combustion efficiency, and in the treatment of water, said magnets are oriented with differing poles adjacent said conduit.

4. A device as claimed in Claim 3, wherein there is at least one magnet located at a first location with its north pole adjacent the conduit and at least a second magnet located at a second location with its south pole adjacent the conduit.

5. A device as claimed in any preceding Claim, wherein said bracket means comprise at least an upper and a lower bracket, adapted to be secured together around a conduit, at least one of said brackets providing a seating surface for at least one of said magnets.

6. A magnetic fluid treatment method comprising mounting a plurality of neodymium-based permanent magnets in a predetermined orientation about a fluid

conduit.

7. A method as claimed in Claim 6, wherein said magnets are oriented with their polar axes extending substantially radially from the central axis of said conduit.

8. A method as claimed in Claim 6 or Claim 7, wherein in the treatment of gas and liquid fuels for improved combustion efficiency, and in the treatment of water, said magnets are oriented with differing poles adjacent said conduit.

9. A method as claimed in Claim 8, wherein at least one magnet is located at a first location with its north pole adjacent the conduit and at least a second magnet is located at a second location with its south pole adjacent the conduit.

10. A method as claimed in any one of Claims 6 to 9, wherein said magnets are located on said conduit by bracket means comprising at least an upper and a lower bracket, adapted to be secured together around a conduit, at least one of said brackets providing a seating surface for at least one of said magnets.

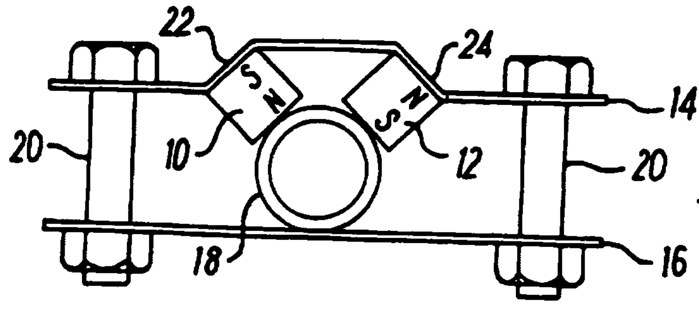


FIG. 1

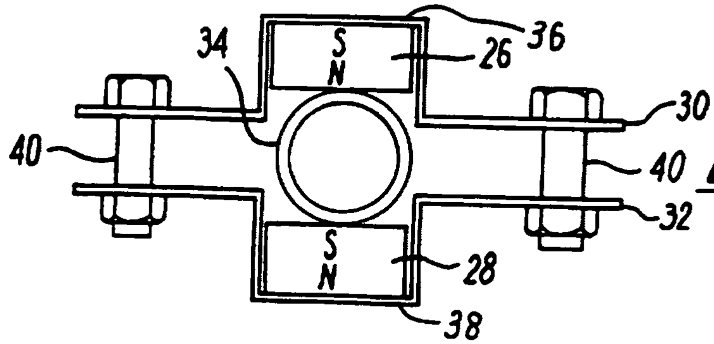


FIG. 2

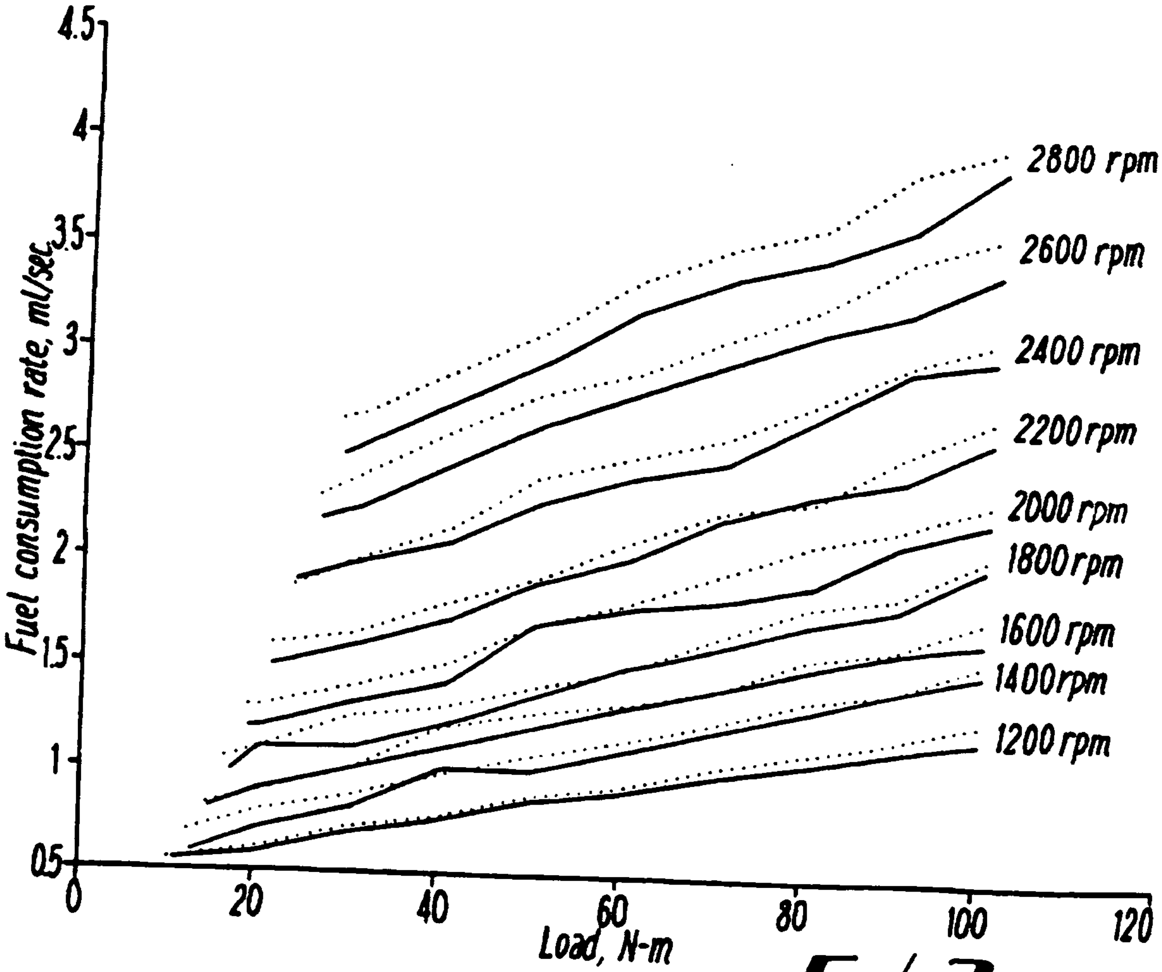


FIG. 3

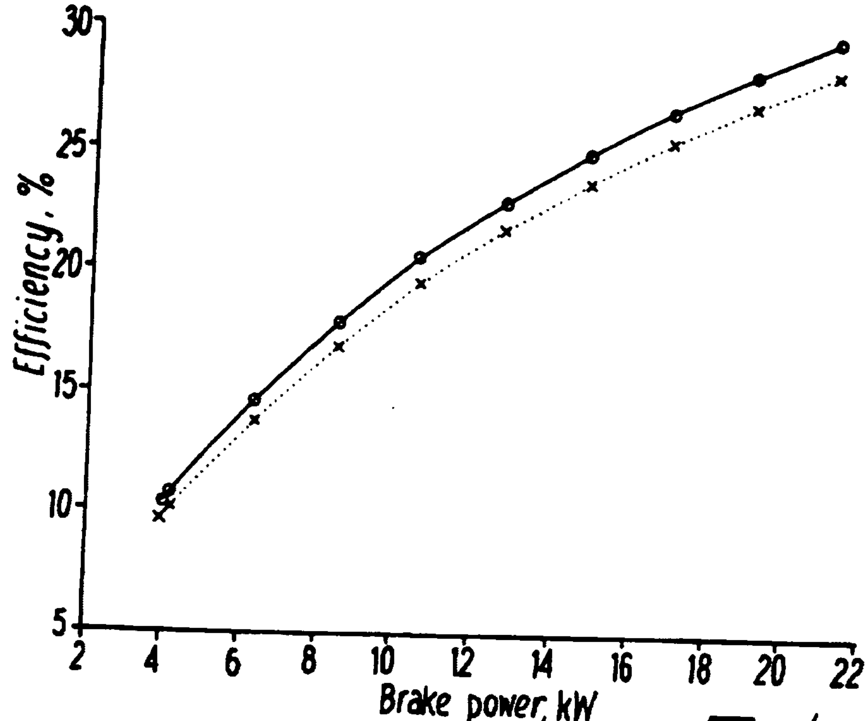

Efficiency, %
30
25
20
15
10
5
2
4
6
8
10
12
14
16
18
20
22
Brake power, kW

FIG. 4(a)

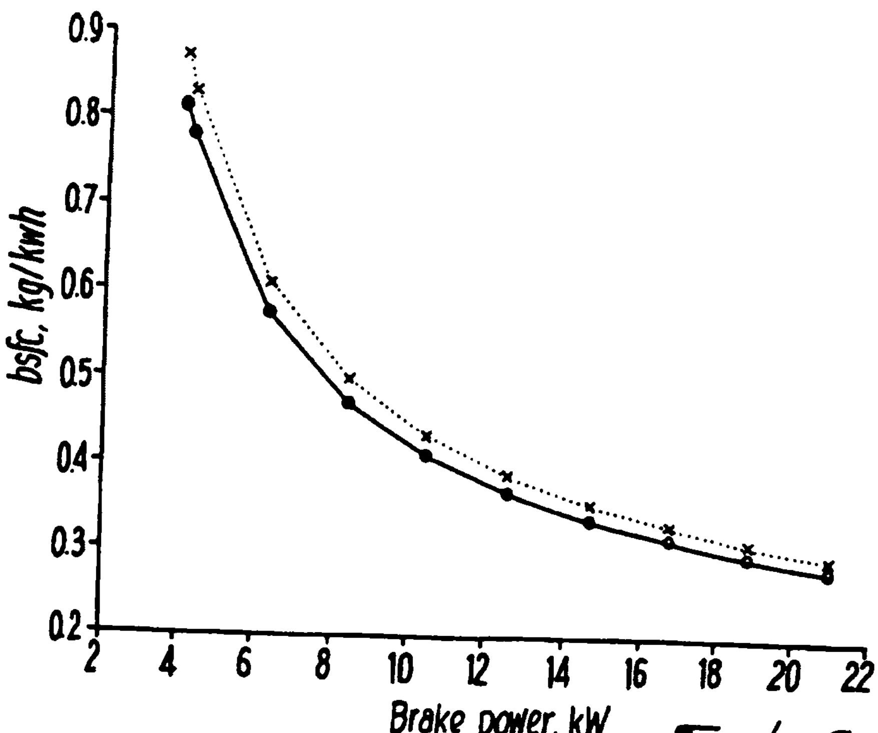

bsfc, kg/kwh
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
2
4
6
8
10
12
14
16
18
20
22
Brake power, kW

FIG. 4(b)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 95/02344

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F02M27/04 C02F1/48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F02M C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,5 055 189 (ITO MASASHI) 8 October 1991 see claims 1,3; figures ---	1-10
X	EP,A,0 392 097 (ITO MASASHI) 17 October 1990 see claims 1,3; figures ---	1-10
X	EP,A,0 501 589 (ZWOLLE HANDELSBURO) 2 September 1992 see claims 1,2; figure 2 ---	1,6
X	US,A,5 269 916 (CLAIR COLONEL) 14 December 1993 see column 2, line 50 - line 52; figures --- -/--	1-4,6-9

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 January 1996	02.02.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Alconchel y Ungria,J

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 95/02344

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,5 269 915 (CLAIR COLONEL) 14 December 1993 see column 4, line 64 - line 66; figures ---	1,6
X	DE,U,91 16 358 (STRAUB) 20 August 1992 see claim 3; figure -----	1,6

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 95/02344

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-5055189	08-10-91	JP-C-	1811509	27-12-93
		JP-A-	2131186	18-05-90
		JP-B-	5018635	12-03-93
EP-A-0392097	17-10-90	NONE		
EP-A-0501589	02-09-92	BE-A-	1004269	20-10-92
US-A-5269916	14-12-93	NONE		
US-A-5269915	14-12-93	AU-B-	6530594	08-11-94
		WO-A-	9424053	27-10-94
DE-U-9116358	20-08-92	DE-A-	4132027	01-04-93